BOOK REVIEWS

The Evolution of Sex: An Examination of Current Ideas. Edited by Richard E. Michod and Bruce R. Levin. 1988. Sinauer Associates Inc., Sunderland, MA 01375. 342 p. $29.95, paper; $60.00, cloth.

Understanding the selective pressures responsible for the origin and maintenance of sex is one of the big unsolved problems in evolutionary biology. This collection of 17 chapters by many of the leaders in research on this topic serves both as a series of reviews and as the airing of new ideas. The book differs from previous treatments in its breadth, with chapters on sex in bacteria and the molecular basis of recombination, and in the degree to which different hypotheses are integrated. Contributors also served as reviewers of the chapters, so cross-references are extensive. The book contains a common literature-cited section; chapters in which the references are cited are indicated. A reasonably complete index follows.

What do we mean by the word "sex"? Most dictionaries equate sex to *genital union* and *gender,* i.e., the differentiation into male and female. Not usually mentioned is *mixis,* the mixing of hereditary material, from the same or different individuals, so as to produce new genotypes. This latter meaning is the topic of this book. Such mixing may or may not be associated with reproduction. As Ghiselin points out, *recombination* is usually used as a synonym for mixis. Thus, this book might more appropriately have been titled "The Evolution of Recombination". Felsenstein wonders sarcastically how many fewer copies of a book on this topic might be sold if the word "sex" were not in the title.

Why the renewed interest in the evolution of sex? At least four books have been written on this topic in the last 15 years. Perhaps the main reason is the shift away from group selectionist thinking that began after the publication of Williams' 1966 book, *Adaptation and Natural Selection.* Since that time, most hypotheses have approached the problem from the standpoint of costs and benefits to individuals. Given the two-fold cost of meiosis, along with the related costs of recombination, producing males, and the act of mating itself, all of which are borne by individuals, it is difficult for many evolutionary biologists to see how the benefits, either to groups or to individuals, could compensate.

What are the main hypotheses concerning the evolution and maintenance of sex? I had hoped to come away from this book with a clear idea of the different hypotheses, but there was a good bit of disagreement among the authors in terms of how many different hypotheses there are and how these interrelate. Most agree that there are two basic types of advantages, that of mixis itself, and the repair of errors in DNA. At least three chapters argue for the importance of mixis in the evolution of sex, wherein new genetic combinations are generated that can deal with variable environments. Three other chapters argue for the importance of sex in DNA repair and the avoidance of Muller's ratchet, the inevitable accumulation of deleterious mutations faced by asexually reproducing organisms. Three more chapters argue that DNA repair is more important for prokaryotes and mixis more important for eukaryotes.

A third hypothesis for the evolution of sex is presented in the chapter by Hickey and Rose. They challenge the notion that sex is an adaptation that evolved for one of the above functions; rather, it results from the evolution of parasitic, or "selfish" DNA sequences that use cycles of germ cell fission and fusion to spread horizontally through populations. Thus, they argue that sex may evolve not at the group or individual level, but at the subgenomic level.

Seger and Hamilton further develop Hamilton's host-parasite model. The basic idea is that parasites (and I assume also other pathogens?), because of their short generation times, can evolve new methods of attack faster than their hosts can evolve new methods of defense. The host's main defense may be to produce genotypically diverse offspring generated by recombination, amounting to a continually "moving target".

Although there is by no means agreement among these contributors, the two hypotheses stated by Bell seem to reflect the views of most of them: 1) sex prevents the irreversible accumulation of mutational damage by combining deleterious mutations that have risen independently into the same line of descent for elimination by selection; and 2) the genetic variance created as a by-product of the above process is adaptive in heterogeneous environments.

Most of the chapters are clearly written and can be deciphered even without completely understanding the formulae. A basic understanding of population genetics is assumed, however. This book is highly recommended reading for any biologist interested in the puzzle of sex.

STEPHEN H. VESSEY

Department of Biological Sciences
Bowling Green State University
Bowling Green, Ohio 43403

Structure across a Mesozoic ocean-continent suture zone in the northern Sierra Nevada, California. S.H. Edelman, H.W. Day, E.M. Moores, S.M. Zigan, T.P. Murphy, and B.R. Hacker. 1989. Geological Society of America, P.O. Box 9140, Boulder, CO 80301. Special Paper No. 224. 64 p. $15.00 paperback.

The current scientific revolution in geology, referred to as the Theory of Plate Tectonics, can arguably be considered two separate developments. The first phase, during the late 1960's-early 1970's, involved the growing appreciation among geologists for the processes of rifting (the break-up of a continent and subsequent production of new oceanic crust) and subduction (the overriding and destruction of oceanic crust). Together these processes explain the motion of large lithospheric plates across the earth's surface, the formation of new ocean basins, development of mountain chains, and the locations of volcanic arcs.

During the late 1970's-early 1980's, geologists became increasingly aware of the importance of lateral transport of small lithospheric plates ("microplates" or "terranes") along faults of crustal dimensions. Many of the initial

studies were conducted in the Cordilleran of western North America, which is now best understood as a patchwork of terranes that accreted to North America during the past 200 million years. Each terrane is characterized by a distinct geological history prior to accretion, which can be deciphered by its stratigraphy, age relations, and deformational history. The accretion event itself may have been accompanied by volcanism, emplacement of plutons, faulting, deformation, and/or metamorphism.

Much of the present geological research being conducted in western North America focuses, as does the report by Edelman et al., on terrane analysis. This involves identifying and mapping individual terranes, establishing their paleogeographic position, dating the accretion event, determining the relationships between adjacent terranes, and calculating their path of translation from some earlier position to the geographic location where the collisional event occurred.

The monograph by Edelman and others applies terrane analysis to a geologically complex region in northern California, where a series of oceanic terranes "docked" with North America. As each successive terrane accreted, the resulting deformation and metamorphism altered and scattered (offset along faults) the earlier terranes. An attempt to unravel the geologic history of this region requires first determining the conditions of the *youngest* accretion event, then back-calculating to remove its effects in order to reconstruct the conditions of the second-youngest accretion (i.e., remove the effects of metamorphism, take-out the effects of offset along faults). Each sequential reconstruction becomes less well-constrained, for obvious reasons, and many alternative scenarios could be envisioned. This particular region in California has been controversial among geologists as a result of the widely different explanations that have been proposed.

In general, the monograph is well written, with useful and legible maps and figures. To follow the details of the authors' arguments probably presupposes some understanding of the regional geology and geography. As is usually the case, the best way to follow this argument would be on a field expedition through the region, possibly accompanied by the authors (geologists actually do this — most professional conferences feature field trips to the local geology).

To general readers, there are several valuable concepts to glean. First is a general understanding of the tools and methodology of terrane analysis. For example, various figures show how disparate rocks are recognized as part of a coherent ophiolite sequence (slice of oceanic lithosphere). Other figures demonstrate how melange sequences are recognized. The work provides a useful review of the use of small-scale structural features (such as stretching lineations) in reconstructing the kinematics of faults. Second, the general reader might gain insight into the geological complexity of interpreting accretional terranes. This task has forced a high degree of synthesis among geologists, applying concepts from igneous and metamorphic petrology, sedimentology, stratigraphy, radiometric dating, magnetostratigraphy, paleontology, and structural geology. The necessary combination of detail and "big-picture" geology provides a useful lesson to students (and reminder to professionals).

JAMES E. EVANS

Department of Geology
Bowling Green State University
Bowling Green, Ohio 43403

Animal Research and Ethical Conflict. An Analysis of the Scientific Literature 1966-1986. Mary T. Phillips and J. A. Sechzer. 1989. Springer-Verlag, New York, NY. 251 p. $69.00 hardcover.

An ethical consideration of animal research is a timely topic. The authors have traced early events in Europe and the United States through World War II, techniques for obtaining background information, publication of items concerned with animal research and related work through 1985. Inroads were made into the rather united front of researchers during the 1980's.

A new era for the research (and teaching) community has dawned with the advent of the Institutional Animal Care and Use Committees (IACUC). Will they be effective in reviewing, monitoring and changing protocols and institutional activities relative to animals? If these committees are not effective and this fact can be documented, animal activists may play a greater role in institutional life relative to animals, with a graphic decrease in their use. Several steps have been taken, such as accreditation by the American Association for Accreditation of Laboratory Animal Care (AAALAC), which have placed animal research in advance of the use of animals in industry, for pleasure, and so on. As a result of these steps, the animal research facility at a medical center is clean and staffed by well-trained personnel, while the local humane society may be dirty and maintained by well-intended, but poorly-trained, volunteers.

Pain and discomfort are the most important issues in the animal research field. Here, there are double standards. Analgesic drugs are easily available and used for research animals, while kosher killing causes little concern among animal activists. The pound seizure issue, which concerns the use of random animals, is laden with tension. Victories have been claimed on both sides, but the fact remains that 11 states prohibit the release of pound animals for investigational studies. Through all of this, it is obvious that an institution must be accredited to survive as a recipient of major grants, and that sloppy and callous investigators will put the institution at risk in a number of ways.

Chapter 7 summarizes animal legislation in other countries. This is convenient for the investigator contemplating a sabbatical or tour in a foreign laboratory. The annotated bibliography is grouped according to years during which articles and books were published. I would have preferred the author and title to be written in bold type and listed alphabetically with an exhaustive index of key words in context, years, source, and other details.

Pertinent legislation, i.e., 1) The Animal Welfare Act, 2) The Health Research Extension Act of 1985, 3) Interdisci-

plinary Principles and Guidelines for the Use of Animals in Research, Testing and Education, and 4) the 1986 Report of the AVMA Panel on Euthanasia, are included. It is convenient to have these in an accessible format. The chronology of significant events from 1966 to 1989 is useful for teaching purposes and is included as Appendix D. Journals in which research animal welfare related items were found are listed. The index is not exhaustive.

In sum, this is a useful reference book for the purposes for which it is intended. It has a place in the central library of a life science institution, as well as in the satellite library of the animal facilities or vivarium. Some biological scientists and students may wish to have a personal copy.

A haunting thought surfaces while reading this text. The development of the humane movement in England forced some English investigators to travel to France to study animals. Will a bureaucratic, inefficient and restrictive climate in the United States force American scientists to leave in order to do their work or give foreign countries an advantage in the biological sciences? Currently, the United States enjoys advanced standing in education and medicine. Will these golden years of advancement in education and medicine continue in North America? A study of the past may hold a key to the future.

DONALD H. CLIFFORD

Division of Laboratory Animal Medicine
Medical College of Ohio
3000 Arlington Avenue
Toledo, OH 43699

Cell Cycle Control in Eukaryotes. Edited by D. Beach, C. Basilico and J. Newport. 1988. Cold Spring Harbor Laboratory, Current Communications in Molecular Biology, Cold Spring Harbor, NY. 211 p. $20.00.

This work is a collection of short articles which resulted from a meeting held at the Cold Spring Harbor Banbury Conference Center in March 1988. One of the purposes of the meeting was to bring together researchers working with very disparate model systems, ranging from diatoms through fly and frog embryos to yeast and mammalian cell lines, for presentations and discussions in the areas of both growth control and cell-cycle control, hoping for productive "cross fertilization". The volume contains a series of brief mini-reviews of current research on topics related to the molecular basis of cell-cycle control. Topics covered include growth control, regulation of G_1/S (initiation of DNA synthesis) and regulation of mitosis. Each paper is not meant to be either a full review or a full research paper, but rather a little of each; thus, some of them contain little documentation, but each serves as a good source of current references as well as providing a glimpse at work currently in progress. This volume should serve to pique interest in a variety of topics related to cell-cycle control and allow the reader to appreciate ways in which they may be related. Some papers are more readable to a scientifically literate reader than are others, but on the whole, the volume is well worth consideration if one is seeking a brief overview of current research in the area of cell-cycle control. Additionally, it provides a good preliminary source of references for those just starting to investigate this field.

EILEEN UNDERWOOD

Department of Biological Sciences
Bowling Green State University
Bowling Green, OH 43403

Mathematics and the Unexpected. Ivar Ekeland. 1988. The University of Chicago Press, Chicago, IL. 160 p. $8.95 paperback, $19.95 hardcover.

Differential equations permeate any analytic understanding of the universe we live in. They were conceived by Newton, who used them to prove mathematically that the planets orbit the sun following elliptical paths. Although few (no?) applications are of the same brilliance and revolutionary nature as Newton's original work, differential equations continue to be of central importance in problems occurring in astronomy, biology (predator-prey balances), weather forecasting, sport, etc. Unfortunately, mathematicians as yet can only solve a few of the differential equations that crop up in everyday life, and have to be content with approximate solutions. Even this is none too easy and raises the question "How reliable are the approximations?"

In his solution to the problem of determining the path of the Earth around the sun, Newton completely ignored the effects of the other bodies in our solar system and their attractive force on the Earth. If we ignore all the other planets and moons in our solar system except for Jupiter, the biggest, and try to solve the equations for Earth with respect to the gravitational pull of the sun and Jupiter alone, we are unable to do so. Despite this, using perturbation theory, it is possible to obtain a good enough approximation that NASA has been able to use it to land men on the moon, visit Mars, and most excitingly of all, send Voyager spacecraft on paths to have rendezvous with Jupiter, Saturn, Uranus and Neptune. In other words, the gravitational effect of the sun alone on the Earth so overrides the effects of the rest of our entire universe that, from a pragmatic viewpoint (and scientists are very pragmatic people), we can use Newton's solution and determinable perturbations thereto when we wish to travel in our own solar system.

Another example worth considering is the pendulum. If released from any position (except vertical), it oscillates and comes to rest in the vertical with weight down. The path travelled by the weight is a damped wave curve. If released from the vertical with weight up or down it remains stationary, but in the former case, a slight change from the vertical results in a path widely discrepant from the original weight up position. This is an example of an unstable equilibrium.

An even more extreme example of instability is provided by long-term weather forecasting. Even computer round-off error is enough to ensure that one year from now the predicted solution to the differential equations will be vastly inaccurate. This is known as the "butterfly effect". The presence or absence of a single butterfly is

enough to change the solution. Consequently, there is no adequate approximation for long-term weather forecasting; so weather is "unexpected" in the long-term, and the solutions are unstable.

The study of paths for stable and unstable solutions to differential equations is essential but difficult. The discipline is known as "Dynamical Systems" and is a mixture of topology and analysis. The unstable equilibria are singularities and there is a rudimentary (topological) classification thereof in certain cases, formulated by René Thom. This classification can help us to understand, in general terms, solutions of differential equations and in some cases get good enough approximations to make predictions. This line of reasoning leads to a study known as "Catastrophe Theory"; it is controversial and although some work has been done by top-rank mathematicians, some of the more grandiose claims by others has not helped its cause.

Ekeland's book attempts to go into these topics in considerable detail, making them accessible to the layman. Essentially, there are four essays, the linkage between them being minimal. The first deals with Kepler and Newton and is outstanding. The second deals with Poincaré and his legacy and is the most ambitious chapter; it deals with stability and instability and plotting regions of stability, impossibility of solutions, and related concerns. The third essay deals with Catastrophe Theory and is a very good account for the layman; it tries to avoid contention and clearly points out the advantages and limitations of applying Thom's "classifications". The fourth essay is a fascinating attempt to examine the concepts of time in "The Odyssey" (past and future mirror each other) and "The Iliad" (the "now") and shows how both are present in our thinking today. The style of each essay is (perhaps necessarily) dramatic. This makes several of the points extremely striking and well expressed, but at times the hyperbole becomes irritating and unnecessarily contentious. Personally, I learned a lot from reading the book and would recommend it, provided the reader keeps in mind that the views expressed are those of an individual, the explanations are only approximately accurate at times (especially with regard to Poincaré, a part I found confusing), and that the author equates pragmatism with dishonesty. How else is one to interpret the passage (which shows the strength and weakness of the book):

> "This is the situation toward the end of the nineteenth century. Unfortunately, the apple is rotten at the core. Science has striven for over a century to build an imperishable temple on the foundations Newton laid, and the construction is dazzling indeed. But the columns are already cracked; as a matter of fact, they were cracked from the very beginning, and they will soon fall and bring down the whole building. These cracks are there to be seen: one needs a really close look, but they certainly can be detected even if there is no saving the construction. But the wardens of the temple keep the bad news to themselves and try to paint everything over."

Many readers of this review will wish to know how this book compares with the recent "best seller" A Brief History of Time by Professor Stephen Hawking. Whereas Hawking's book deals with the entire universe and the theories involved in understanding it (gravity, relativity, quantum theory, etc.), Ekeland's book deals in a more down-to-earth way (pun intended) with the nuts and bolts of solving equations that arise from one of these theories. Both objectives are difficult to accomplish and both authors are to be lauded for achieving so much and concerning themselves with the layman in such a superb way. If Ekeland's book doesn't achieve quite as much fame as Hawking's, it is only because the competition is so superb.

A. M. W. Glass

Professor
Mathematics and Statistics
Bowling Green State University
Bowling Green, OH 43403

Down and Out in America: The Origins of Homelessness. Peter H. Rossi. 1989. The University of Chicago Press, Chicago, IL. 246 p. $15.95 Cloth.

Sociologist Peter Rossi has been one of the foremost social policy researchers for over two decades. His book, Down and Out in America, is probably the most thorough book on homelessness in the United States to date. The book relies heavily on Rossi's own study of the Chicago homeless, technically the best designed study of today's homeless population. The methodological details of the Chicago study are provided in an appendix. Another attractive feature of the book for social policy researchers is the annotated bibliography of homeless studies that is provided in another appendix.

One of Rossi's essential points is that homelessness is primarily a poverty problem, and that there are many other poor people who are on the verge of becoming homeless in the event of any number of emergency situations (e.g., a sick child or a lay-off). The average American can weather these problems because of reserves such as health and unemployment insurance. In fact, research shows that homelessness is episodic for many Americans. During good economic times the marginally poor are able to find jobs and afford housing, but when the economy declines, these workers are the first fired and frequently, because they are not covered by unemployment insurance, they become homeless once again.

After providing illustrative case histories of the types of people who are homeless in the United States in Chapter 1, Rossi provides a history of homelessness in the United States in Chapter 2. Rossi clearly illustrates the two basic struggles that American society and its institutions (government and private) have had regarding treatment policies for the poor in general, and the homeless in particular. First, what jurisdiction is responsible for the poor? Throughout history, many aid programs have been restricted to so-called permanent residents; thus, transients were not given any aid with the exception of a bus ticket out of town. Secondly, government and private institutions have frequently tried to distinguish between the "deserving poor" (usually widows and orphans), and the "unde-

serving poor" (usually young single men) in allocating aid. This chapter also illustrates how the characteristics of the homeless population have changed over time. With the exception of the Great Depression, homelessness in America was primarily a male problem until the 1970's. For example, 3% of the homeless population were female in a 1958 Chicago study, whereas 25% of Rossi's 1985 Chicago homeless sample were women.

Chapter 3 is a technical chapter on how to estimate both the size of the homeless population, as well as the size of the poor population. Unfortunately, because of all the technical details provided, it is possible to miss the main point of the chapter, namely that both the number of poor people and the number of homeless people have increased dramatically since 1970.

Chapters 4 and 5 provide considerable detail on the demographic characteristics of today's homeless population as well as their economic and housing situation. When this information is compared to past studies of the homeless, Rossi concludes that homeless people today are less likely to be employed, have less income, and live in poorer housing than previously. Moreover, today's homeless population is younger, with a heavier concentration of minorities than in earlier years.

In Chapter 6, which is entitled, "Vulnerability to Homelessness," Rossi examines how other factors besides poverty contribute to homelessness. Although earlier research indicated that the percentage of homeless people who were mentally ill and/or alcoholic clearly exceeded the percentage in the general population, there is no doubt that the percentage of mentally ill in today's homeless population (about 33%) is greater than in the past as a result of deinstitutionalization policies of state mental health departments. In this chapter, Rossi also shows that although most homeless people maintain some ties with family and friends, these relationships frequently become strained by an accumulation of troubles, and that eventually many of these families refuse to keep providing emergency shelter and other assistance to their vulnerable relative.

In Chapter 7, Rossi summarizes the causes of homelessness and extreme poverty and offers some policy recommendations. First, there has been a decline in SRO hotels and other low-income housing, as large as 40% in some large cities. Secondly, there has been a dramatic rise in the number of young unemployed black men since 1955; causes for this rapid increase include the post-war baby boom, the loss of unskilled jobs, and the increased number of women entering the labor market. Third, there has been a rapid erosion of the value of welfare benefits over the past 10 years. Unfortunately, Rossi only devotes a few pages to mechanisms for solving the homeless problem. Two recommendations involve administrative changes that could be enacted without legislation. First, state governments could ease the bureaucratic red-tape required for receiving various welfare benefits. Many homeless people qualify for these benefits and, in fact, had them at one time, but lost them through a technical violation (e.g., failing to show that they were still eligible after a specified time period). Secondly, state mental institutions could improve their discharge planning practices and after-care programs so that the mentally ill do not become homeless almost immediately at discharge. However, Rossi is much less optimistic and less specific on how to address the low-income housing shortage and how to increase employment prospects for young black men.

In summary, Down and Out in America is an excellent book for social policy researchers and their graduate students. However, it may be too technical for undergraduates and other scientists. Another book on the homeless which is also well researched, but with less technical jargon, is Address Unknown: The Homeless in America, by James D. Wright. Wright has collaborated with Rossi as well as conducted his own research on the homeless. Like Rossi, Wright also provides the reader with numerous statistics to make his case, but his presentation is more concise than Rossi's. Moreover, Wright's conclusions are stated more explicitly than those of Rossi. However, because both books cover essentially the same material and reach similar conclusions, only those scientists who are themselves studying the homeless probably need to read both books.

ROBERT J. CALSYN

Gerontology Program
University of Missouri-St. Louis
8001 Natural Bridge Road
St. Louis, MO 63121-4499